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diminished volume and so are nearer together; they do not travel to such regions.

Though the reader may not be convinced of the necessity of this explanation, it is certainly most interesting to learn that bubbles of air squeezed through mashed egg masses, and even through artificial mixtures of soot and emulsions, do leave pigmented tracks behind, similar to the sperm track. Some physical explanation of the pigmented sperm track seems forced upon us.

The author then takes up the concentration of pigment upon part of the surface of the frog's egg; the aggregation of pigment about the nucleus in cleavage stages of the frog's egg; the remarkable rearrangements of pigment in isolated cells of frog's eggs when "cytotropic" movements bring them together again; the arrangements of pigment in blastulæ of triton after injury by pressure; and the normal arrangement of pigment in certain cells of the triton in the stages of gastrulation and of formation of neural ridges.

In all cases he applies the same formula: pigment collects in areas of increased pressure and of condensation.

When cells are in active chemical interchange there will be greater adhesion of their applied surfaces and less cohesion of the part of each turned towards its neighbor. The parts of the cells most removed from such interchange will be those of relatively high tension, and in these the pigment, if present at all, may be concentrated by adhering to the shrinking lamellæ. Pigment will be on the denser and chemically inactive sides of cells.

In early stages of development pigment does not indicate active chemical changes where it is found, nor is it of any direct use; it remains inert and is concentrated in areas of condensation or may even be expelled from active areas.

Secondarily, natural selection may have emphasized its occurrence in some places where it happened to be of use.

Aside from the main issue, the author's evidence that invagination and evagination are due to actions of individual cells seems specially interesting.

E. A. A.

**Biological Lectures.** — The substantial character of the work done at the Marine Biological Laboratory at Woods Holl is evinced by the recently published volume of *Biological Lectures* for 1898.[1] The sixteen lectures thus brought together are by well-known authorities, and touch on one side or another almost all the important biological problems of the day. The opening lecture is on the structure of protoplasm, by E. B. Wilson, whose study of the living echinoderm egg has led him to revise his former opinion and declare himself now in favor of the alveolar structure of protoplasm. Too much stress cannot be laid upon the importance which the author ascribes to the study of living protoplasm as a check upon what we assume to be a satisfactory preservation of it by histological means. Five lectures deal with problems of cell lineage: the homologies of cells and cell groups are discussed by E. B. Wilson; the interpretation of the various kinds of egg cleavage as adaptations of the egg is taken up by F. R. Lillie; the importance of protoplasmic movement in the distribution of materials from the nucleus is emphasized by E. G. Conklin; equal and unequal cleavage in annelids is treated by A. L. Treadwell, who points out that those organs which appear early in ontogeny are usually represented by large-bodied cells, irrespective of the distribution of yolk; the origin of the prototroch is considered by A. D. Mead. Closely related to these subjects are C. M. Clapp's lecture on the relation of the axis of the embryo to the first cleavage plane, which is dealt with from the modern experimental standpoint, and T. H. Montgomery's account of the nucleolus. The possible relations of contractility and phosphorescence are pointed out by S. Watasé, who argues for the view that phosphorescence may be a general property of living protoplasm. T. H. Morgan, in considering some of the problems of regeneration, points out the apparent inefficiency of purely mechanical explanations, and suggests to students the importance of keeping the vitalistic standpoint in view. Problems in evolution are represented by H. C. Bumpus's interesting examination of a large number of English sparrows killed in a severe winter storm; the birds eliminated were in one respect or another far removed from the typical form. The question of heredity is dealt with by J. Loeb, as illustrated in the markings of fish embryos, and the present necessity of an analytic treatment is enforced. Paleontology is represented by W. B. Scott's account of North American ruminant-like mammals. An appreciative historical review of Wolff's *Theoria generationis* is given by W. M. Wheeler. Animal psycho-physiology is represented by W. W. Norman's very interesting paper on the question whether the reactions of lower animals due to injury indicate sensations of pain, and C. O. Whitman's elaborate account of the habits of leeches, salamanders, and pigeons. The volume is concluded with brief memorial notices of J. I. Peck, J. E. Humphrey, and W. W. Norman.

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[1] *Biological Lectures, from the Marine Biological Laboratory, Woods Holl, Mass., 1898.* 343 pp. Ginn & Company, Boston, 1899.

G. H. P.